

16 Support System: Bones, Joints and Muscles

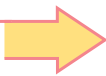


In Activity 12, “What’s Happening Inside?” you learned about the functions of the skeletal and muscular systems in supporting and moving your body. In this activity you will learn about muscles, bones, and other structures that work together to allow mechanical motion of your body.

All animals that have skeletons have similar structures. By dissecting a chicken wing, you will see how the muscles, tendons, and bones work together to make the parts of a chicken wing move. You will also learn about some of the other structures and functions of the muscular and skeletal systems.



CHALLENGE



How do the structures in a chicken wing or a human arm enable it to perform its function?

MATERIALS



For each pair of students

- 1 (raw) chicken wing
- 1 pair of pointed, medium or large dissection scissors
- 2 pairs of forceps
- 1 dissecting tray
- paper towels
- 1 toothpick



For each student

- 1 Student Sheet 16.1, “Anticipation Guide: Bones, Joints and Muscles”

**SAFETY**

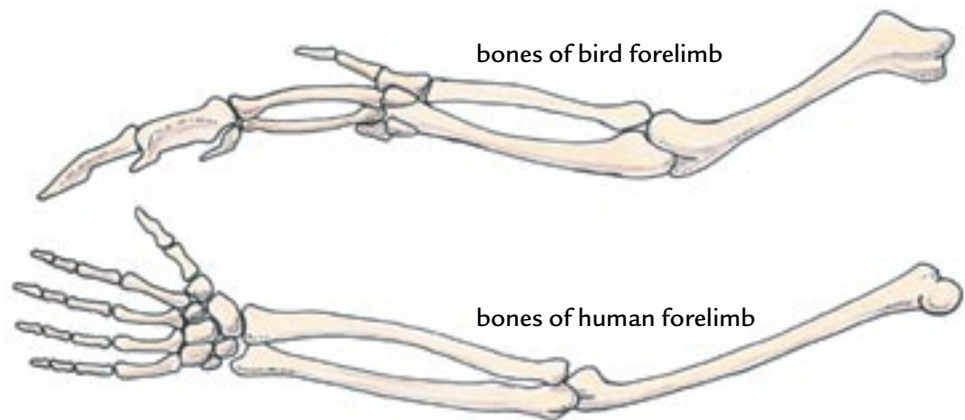
Only one person may dissect at a time. Take turns. Keep your fingers out of the way of sharp instruments. Do not eat or drink in class. Be very careful not to touch your mouth, nose, or eyes when you are working on the dissection. Wash your hands thoroughly with soap and hot water after completing the dissection.

PROCEDURE

Complete the “Before” column of Student Sheet 16.1, “Anticipation Guide: Bones, Joints, and Muscles.”

Part A: Comparing the Chicken Wing to the Human Arm

1. Locate the following structures in your arm: shoulder, elbow, and wrist joints; two forearm bones, one upper arm bone, thumb and finger bones.
2. Examine the whole chicken wing.
3. Without cutting yet, feel the wing. Use your fingers to find structures on the chicken wing that are similar to the human arm structures listed in Step 1.

**Part B: Comparing the Movement of Wings and Arms**

4. Turn the wing so the inside is facing up. Use your forceps to pinch up the skin, and make a small cut with your scissors, as shown in Step A.



*Step A: Making a cut.
Make a small cut in the skin.*

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Step B: Inserting the scissors. Insert the tip of the scissors into the small cut.



Step C: Cutting the skin. Cut the skin along the bone, without cutting the muscle.



Step D: Pulling the tendon. Use your forceps to pull on the tendon.



Step E: Moving the chicken wing. Observe the chicken's "hand" moving toward the lower "arm."

5. As shown in Step B, insert a scissor blade into the cut so that it is parallel to the bones. Be careful that you don't cut through muscle under the skin.

6. As shown in Step C, cut the skin, and peel it away from the muscle, using your forceps and scissors to help you. Expose both major joints of the chicken wing.

Observe the tendons, blood vessels, and muscle. Tendons are the shiny strips of tissue that connect muscles to bones.

7. Use your forceps to pull on tendons individually. When muscles contract, they pull on tendons, so when you pull on a tendon, you are modeling the action of a wing muscle (Steps D and E).

Try to get a part of your chicken wing to "wave" back and forth by pulling on tendons attached to two opposing muscles.

8. Cut through the muscles until one of the chicken's lower wing bones is clearly visible.

9. Break the bone with your fingers. Notice how resistant the bone was to bending.

10. Examine the inside of the chicken bone. Use a toothpick to explore the texture of the center of the bone, the marrow.

11. Set the chicken wing out on the tray so that you can see all of the structures.

12. Wash your hands thoroughly with soap and hot water. Don't touch the chicken after you wash.

13. In your science notebook, draw a labeled diagram of the chicken wing. Include the tendons and the structures you located in Step 6.

14. In your notebook, describe what you had to do to make the wing move in opposite directions. Record your observations of the inside of the chicken bone.

15. Follow your teacher's directions for disposing of the chicken wing and for final clean up.

ANALYSIS

1. How are human arms and chicken wings similar? How are they different?
2. What evidence did you find that would help explain how birds move parts of their wings back and forth? Draw a diagram showing muscles, bones, and tendons to help explain your answer.

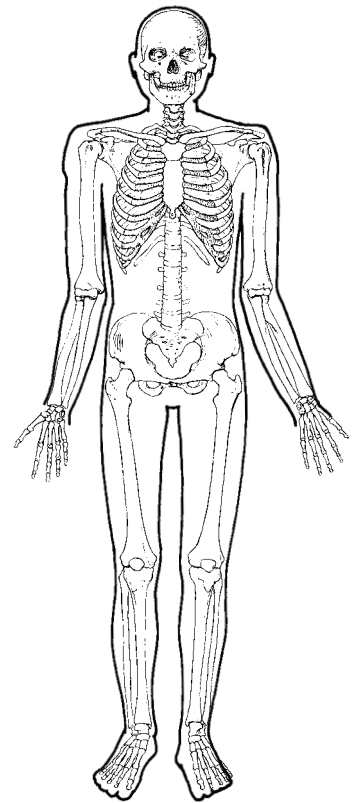
Part C: Bones, Muscles, and Joints

16. Complete the following reading to learn more about muscles and joints.

READING

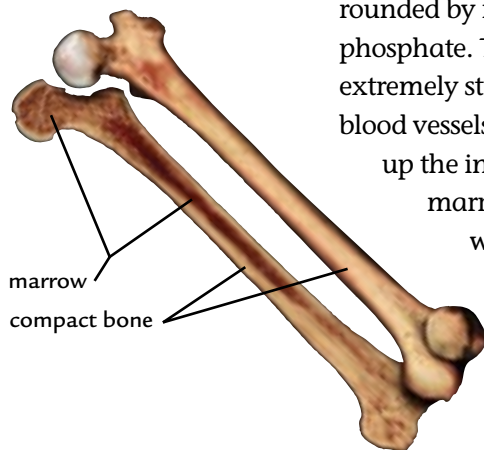
Bone Function

The bones in your arm, just like those in a chicken wing, function to support and move your arm. All of the bones in your body make up your skeleton. Imagine what your body would look like without bones! In addition to supporting and moving your body, bones also protect your internal organs. For example, your skull protects your brain, your vertebrae protect your spinal cord, and your ribs protect your heart and lungs. Bones have other functions that you may not have thought of before. These include manufacturing blood cells and maintaining the body's calcium balance.



Bone Structure



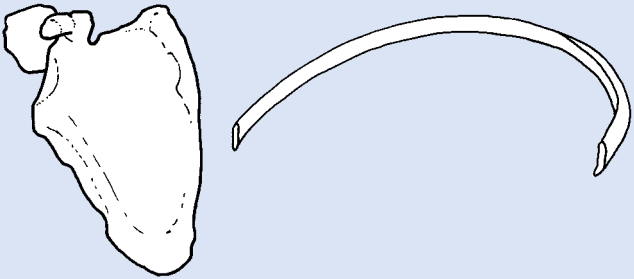

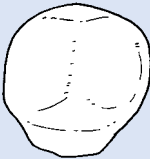
Bone is living tissue made of bone cells surrounded by minerals that contain calcium and phosphate. The walls of bones are hard and extremely strong. Small channels that carry blood vessels and nerves run through the bone. Spongy, lighter bone makes up the inside of bones. The spaces in this spongy bone are filled with bone marrow. If you used a magnifier to look at the marrow of the chicken wing, you may have noticed this.



The bone marrow inside the long and flat bones of the body has a special function. Red blood cells, white blood cells, and platelets are made there. Red blood cells carry oxygen to all parts of your body, white blood cells fight infection, and platelets help blood clot when tissue has been damaged.

Types of Bones

You have five types of bones in your body. They are listed in the table below.

Table 1: Types of Bones		
Bone type	Examples	Illustration
Long bones	Arms, legs, fingers	
Short bones	Ankles, wrists, fingers, toes	
Flat bones	Ribs, shoulder blades	
Irregular bones	Vertebrae, bones of the ear	
Sesamoid bones	Some joints, such as the kneecap	

Go back to the diagram of the skeleton at the beginning of this activity, and find examples of each kind of bone.

Bone Growth

You were born with more than 300 bones. At birth, your bones were made mostly of cartilage, a softer tissue. The tip of your nose is still made of cartilage. If you move it back and forth you can feel how soft and flexible it is.

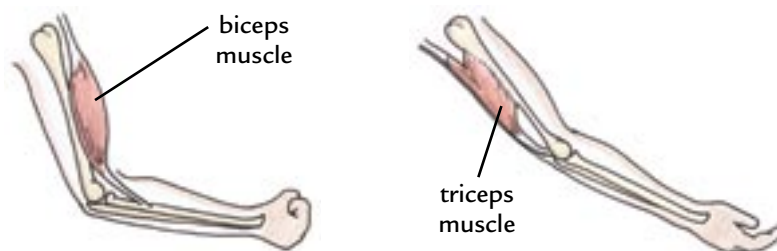
The part of your nose that is made of cartilage is attached to the bones of your face. Shortly after birth, most of the cartilage in your body began to form bone, and some bones fused together as you grew. For example, as a baby your skull was made of many small bones, and as you grew it became one solid bone. By the time you are an adult you will have only 206 bones, and about half of them will be in your hands and feet. As you grow older, the cartilage that makes up the shaft or long part of a bone hardens from the center outward. Most bones continue to grow until you are about 20 years old.

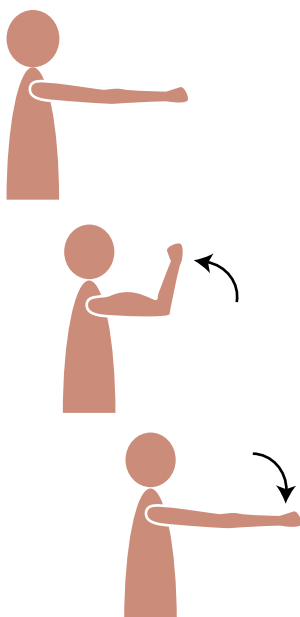
Importance of Calcium

Even though bones stop growing bigger as you reach adulthood, they are made of living tissue capable of repair if the bone is broken. Calcium is the mineral that makes bones hard. But calcium is also needed throughout your body. If you do not have enough calcium in your diet to meet your body's needs, your body takes calcium from your bones. This reduces the density of the bones and contributes to a condition called osteoporosis, in which the bones become weak and more likely to break. While this is most common in older people, the condition often begins in teens and young adults. The best way to prevent osteoporosis is to drink and eat a lot of calcium-rich foods, such as milk and other dairy products while you are young and to continue to take in plenty of calcium throughout your life.

Muscles

When you pick up your backpack, move your tongue to speak, or breathe in and out, muscles in your body are causing this to happen. Muscle tissue is made of muscle cells, which are specialized for movement. When a muscle is stimulated by the nervous system, it contracts. As a muscle contracts, it shortens or bunches up. When you pulled on the tendon of the chicken wing, you simulated what happens when a muscle contracts. The motion of bones such as the ones in a chicken wing or your arm are controlled by a pair of muscles—one set of muscles contracts while the other set relaxes.





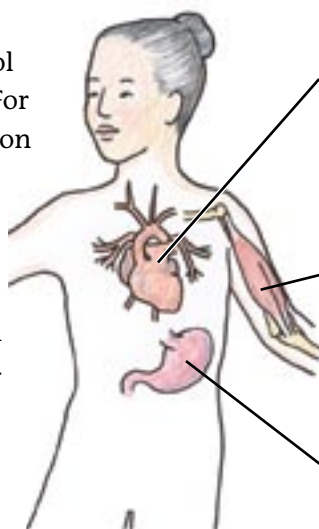
To investigate the muscles in your arm, begin by holding your arm out in front of your body, then pull your hand up toward your face as shown in the diagram at left. Feel what the muscles are doing on the top of your arm—they are contracting! The muscles on the under side of your arm are relaxing. The muscles in your inner arm that contract and pull your forearm up when you “make a muscle” are your biceps. Now, move your hand away from your face and the muscles on the top of your arm will relax while the muscles below contract. The muscles in your outer arm that contract when you straighten your arm are your triceps.

Remember that when you dissected the chicken wing you observed that muscles do not attach directly to a bone. Instead, a **tendon** attaches a muscle to a bone. In the chicken wing, the tendon was the shiny strip of tissue that you pulled on to make the wing move. Ligaments attach bones to other bones in a joint for stability, while tendons attach muscles to bones so the bones can move.

- It takes fewer muscles to smile than to frown.
- Every day your muscles do enough work to lift 24,000 pounds onto a 4-foot-high shelf.
- There are more than 600 muscles in the human body.

You have three types of muscles, listed below:

- Skeletal muscles attach to your skeleton and move your bones. They also move other parts of your body, such as your eyes. Skeletal muscles are voluntary, which means that usually you have to think about moving them.
- Cardiac muscle is the muscle tissue that is in your heart. Individual cardiac muscle cells have the ability to pulse or beat on their own. When cardiac muscle cells touch other cardiac muscle cells, they beat together.
- Smooth muscles control your internal organs. For example, the contraction of smooth muscles moves food through your digestive system. These muscles are involuntary, which means they work without you having to think about them.



cardiac muscle cell



skeletal muscle cell

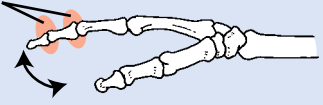
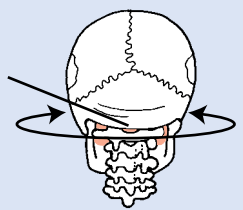
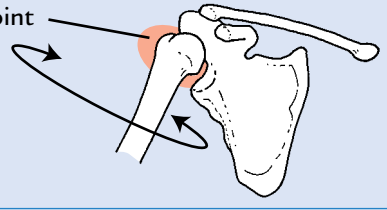
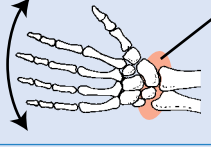
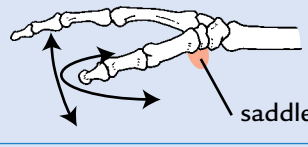
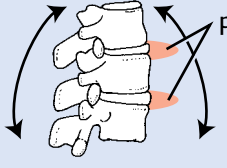
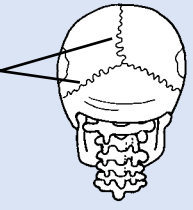


smooth muscle cell

Joints

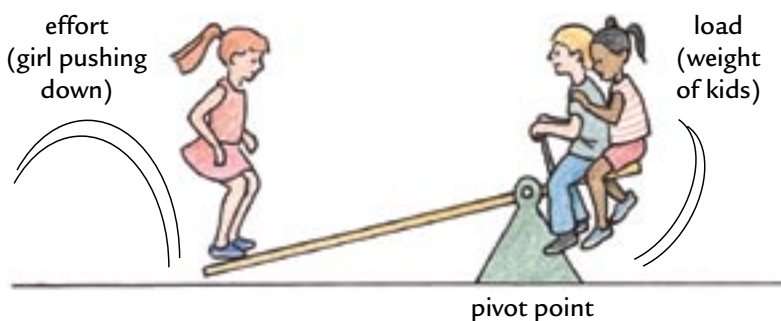
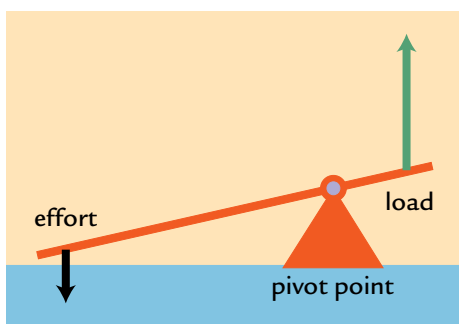
A **joint** is the place where two bones meet. Long fibers called **ligaments** connect one bone to another bone in a joint. Ligaments make a joint stable while still allowing it to move. Table 2 shows the types of joints and where they are found. These joints allow your body to move in different ways.

Table 2: Types of Joints

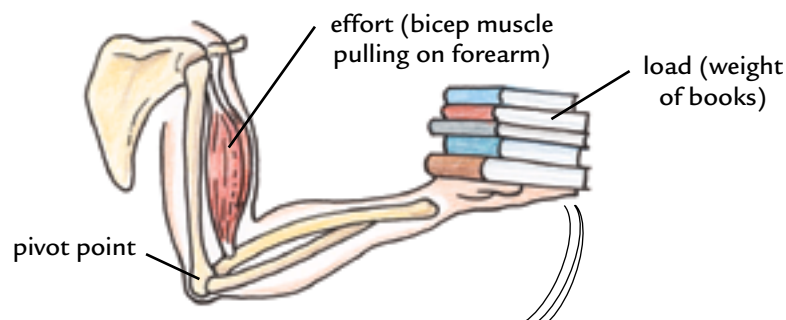
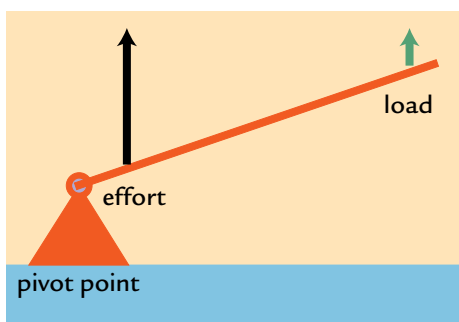
Joint type	Type of motion	Found in the body	Illustration
Hinge	Forward and backward	Knees, elbows, fingers	 <p>hinge joint</p>
Pivot	One bone rotates around another	Head on spinal column	 <p>pivot joint</p>
Ball and socket	Swing freely in a circle	Hip, shoulder	 <p>ball and socket joint</p>
Gliding	Bending, flexing	Wrist, ankle	 <p>gliding joint</p>
Saddle	Forward, backward and side to side	Base of thumb	 <p>saddle joint</p>
Partially movable	Very slight	Vertebrae in spine	 <p>partially movable joint</p>
Immovable	No movement	Bones of skull	 <p>immovable joint</p>

Muscles, Joints, and Bones Working Together

Your muscles, bones, and joints work together to allow your body to move. To understand how this motion takes place, it helps to think of a lever. An example of a lever is a bar with a pivot point that is useful for moving an object, called a load. Moving a load with a lever requires an effort. You probably could not lift your friend off the ground by yourself, but if you use a lever, as shown below, the job becomes easier. In this example, the lever has a pivot point, your friend is the load, and you supply the effort. With this kind of lever, there is a mechanical advantage because little effort is needed to move a large load.



Most joints in your body act like the lever shown below. In this kind of lever, the pivot point and load are at opposite ends. The load is lifted when an effort raises the lever, as shown in the diagram below. When you lift a book from your desk, the bones of your forearm act as a lever. The book is the load, the pivot point is near your joint, and your muscles (biceps) provide the effort.





For the type of lever that makes up your arm, there is no mechanical advantage because more effort is needed to overcome a smaller load. But there is a benefit in our arms acting as this kind of lever. When you lift a heavy book with your hand, your bicep only has to contract a small distance to move the object in your hand a large distance.

The Musculoskeletal System

Because the muscular and skeletal systems work so closely together, they are often called the musculoskeletal system. As you have read, the musculoskeletal system is made of several tissues, including muscle, bone, cartilage, tendons, and ligaments. Each tissue is made of specialized cells that perform special functions. All of these tissues work together to provide structure and support, and to enable the body to move.

ANALYSIS

1. Complete the “After” Column of Student Sheet 16.1, “Anticipation Guide: Bones, Joints, and Muscles.”
2. List at least three functions of the musculoskeletal system.
3. Explain why it is important to get enough calcium in your diet.
4. Explain how a bone’s structure allows it to be strong yet relatively light-weight.
5. Muscles can only contract and relax. How is it possible for you to move in so many different ways?
6.  Choose one type of joint, and list a place where it is found in the body. Describe how the structure of that joint relates to its function.
7.  Explain how cells, tissues, and organs work together to enable the musculoskeletal system to function.



EXTENSIONS

To find out more about how bones and muscles work in the human body go to the *Issues and Life Science* student page of the SEPUP website.

To learn more about X-rays go to the *Issues and Life Science* student page of the SEPUP website.